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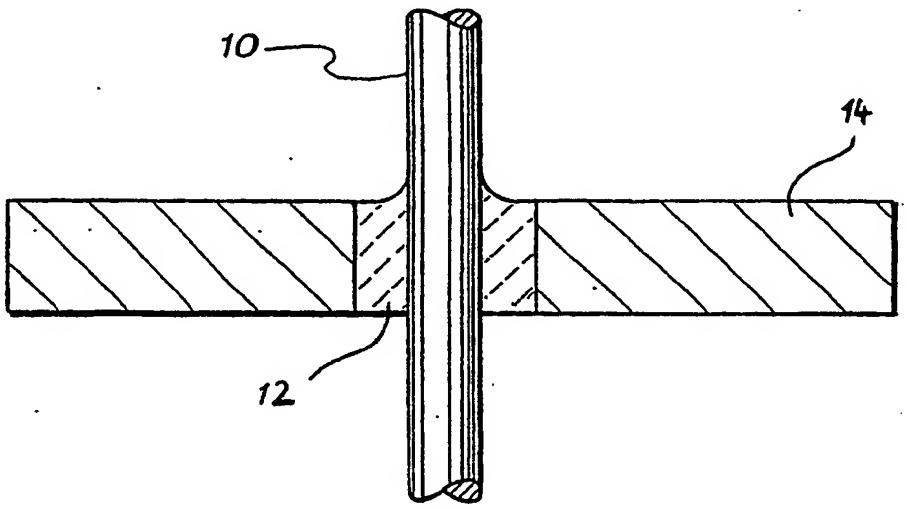
(54) **Electrical device with feedthroughs comprising glass seals.**

(57) Electrical devices, e.g. electrochemical cells, having electrical feedthroughs sealed by glass-to-metal seals are described. For such seals using low-silica glasses, wetting of the metal (14) by the glass (12) is promoted by the use of molybdenum containing alloys to provide the metal surface.

Fig. 1



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ELECTRICAL DEVICE

The invention relates to improvements in and relating to electrical devices, in particular devices incorporating feedthroughs comprising glass seals.

Glass seals are used in various arrangments including batteries and other electrochemical cells. For example, in battery headers, glass seals are used to seal the battery container while allowing one or more electrical contacts to extend through the seal for interior/exterior connection thereto. The term "feedthrough" is used herein to describe such arrangements in generic fashion.

In certain batteries and electrochemical cells, glass corrosion has been encountered. For example, batteries of the Li/SO_2 system, $Li/SOCl_2$ system and other organic electrolyte systems have given rise to corrosion and cracking of the glass seals.

Special glass compositions have been developed to combat such problems. Sandia National Laboratories has been instrumental in developing a low-silica composition glass, that is a composition containing less than about 50 weight % (or mole %) silica, which is generally referred to as TA-23 glass.

Although this glass has been a desirable improvement from the corrosion and cracking standpoint, it has been difficult to find metal alloys which will reliably wet the glass to form a strong, hermetic seal with it and which work well in the other aspects of seal forming such as weldability.

We have now found that particularly good seals for feedthroughs, especially for those contacting agressive chemical compositions, may be produced using the combination of low-silica glasses (in particular TA-23 and similar glasses) and certain molybdenum alloy substrates.

Thus viewed from one aspect the invention provides an electrical device having a metal surface disposed about a feedthrough aperture, said aperture being sealed by a glass body contacting said surface, characterized in that said glass is of a low-silica composition and in that said metal is a molybdenum containing alloy.

In a particularly simple embodiment, the device according to the invention may comprise simply a molybdenum alloy surround disposed about or defining a feedthrough aperture which is sealed by a glass body and which has an electrical lead passing through it. Such a feedthrough assembly may then be welded or otherwise bonded for example into an aperture in a container wall.

Particularly suitably, in the device of the invention the low-silica glass seal, through which an electrical lead may pass, serves to seal off a corrosive chemical composition, such as the content of an electrochemical cell, and in particular a lithium based cell. The glass is preferably of the TA-23 composition or of a similar type and the metal surface it wets is preferably a molybdenum alloy containing greater than about 1% by weight molybdenum, especially preferably at least 2% by weight, particularly preferably 2 to 20% by weight most preferably 2 to 10% by weight of molybdenum. Alloys of molybdenum with metals selected from chromium, iron, nickel, cobalt, niobium and copper, especially alloys containing at least Mo, Cr, Fe and Ni are preferred.

In a preferred embodiment the invention relates more specifically to devices including hermetic, corrosion resistant, compression-type sealed feedthroughs utilizing single or multiple terminal(s) or pin(s) of niobium, molybdenum or tantalum or suitable alloy and contained within a header or sleeve of one of several specific molybdenum alloys, MP35N being preferred. In its most preferred form this preferred seal arrangement is included in an electrochemical cell, e.g. a lithium thionyl chloride cell or cells of other active chemistries such as MnO_2, for example.

The low-silica glass which forms the glass-metal seal in the devices of the invention conveniently has a composition containing no more than 50 weight % silicon dioxide, especially preferably one containing 40 to 50 weight % silicon dioxide.

Using the glass/metal combination according to the invention a hermetic glass to metal seal may reliably be formed, advantageously without requiring the exertion of pressure.

In one preferred embodiment, the device of the invention is an electrical feedthrough assembly comprising an electrical terminal; a glass insulator of the type TA-23 composition positioned around a portion of the terminal and in sealing engagement therewith; and a sleeve or header comprised of a molybdenum containing alloy positioned around a portion of the glass insulator for receiving same in sealing engagement therewith.

In another preferred embodiment, th device of the invention is a glass/metal feedthrough assembly of the compression type including an electrical terminal consisting essentially of molybdenum, niobium or tantalum or a suitable alloy; a glass insulator of type TA-23 composition positioned around a portion of th terminal and in sealing ngagement therewith; and a sl eve or header consisting essentially of a molybdenum containing alloy positioned around a portion of the glass insulator for receiving same in

sealing engagement therewith.

In a further preferred embodiment, the device of the invention is an electrochemical cell of the type including corrosive contents in a container and wherein the container includes an opening carrying an electrical terminal which extends from the exterior of the cell through the opening and into the interior thereof; a feedthrough assembly positioned in the opening and around the terminal, the assembly comprising a sleeve or header consisting essentially of a molybdenum-containing alloy having greater than about 1 weight % molybdenum, and a glass seal carried by the sleeve or header and surrounding the terminal in sealing engagement therewith, the glass being of a type TA-23 composition.

Embodiments of devices according to the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic cross-section of a battery header forming part of a device in accordance with the invention; and

Fig. 2 is a partial schematic cross-section of a feedthrough with sleeve combined with a container for an electrochemical cell according to the invention.

Referring to Fig. 1, a header of typical construction is shown which includes a center pin or electrical contact 10, a glass seal member 12 and an outer conductor member 14. This arrangement and that of Fig. 2 are typical seal arrangements in accordance with the invention. Other arrangements may be used as well and may take any configuration in which the alloy is wetted by the glass.

Referring now to Fig. 2 the feedthrough arrangement in a preferred form includes a terminal 10 extending through a glass seal 12 which is received into a sleeve or header 15. Sleeve 15 may be welded into an opening in a container 16 of, for example, stainless steel.

The component assembly, requiring no forming weights, is placed in an oven or furnace and heated so causing the glass to wet the metallic components forming a hermetic seal between the glass and the metal components. Such a feedthrough may thereafter be welded if necessary, into any desirable container or the like.

In its preferred form, terminal 10 consists essentially of molybdenum, niobium or tantalum or a suitable alloy. The glass 12 is of the low-silica type such as TA-23 which is of the following composition, referred to herein as "Type TA-23 composition":

Composition	Weight % Oxide
SiO_2	44.95 ± 4.0
Al_2O_3	20.0 ± 2.0
B_2O_3	8.0 ± 1.0
La_2O_3	2.0 ± 0.5
CaO	12.0 ± 1.0
MgO	7.0 ± 1.0
SrO	6.0 ± 1.0
CoO	0.05 ± 0.02

In this glass, the CoO concentration may be reduced or CoO may be entirely omitted and such a resultant composition (most preferred herein) is also included within the term "Type TA-23 composition" as used herein. Such a composition will generally be within about the following composition, preferably;

Oxide	Weight %
SiO_2	45.0
Al_2O_2	20.0
B_2O_3	8.0
CaO	12.0
SrO	6.0
MgO	7.0
La_2O_3	2.0

The sleeve 15 is of a molybdenum alloy having greater than about 2 weight % Mo, 2-20 weight % being preferred. MP35N is a very suitable alloy, particularly when it is used with a terminal of Mo, Nb or Ta, and in th_ configuration shown in Fig. 2, a compression seal is formed which is hermetic and corrosion resistant. MP35N is of the following nominal composition:

(Weight %)			
Cr	Mo	Ni	Co
20.0	10.0	35.0	Bal
(Bal = balance)			

Examples of other molybdenum alloys which may be used include the following:

(Weight %)				
316SS				
Cr	Mo	Fe	Ni	
17.0	2.5	Bal	12.0	
Hastelloy C-276				
Cr	Mo	Fe	Ni	Co
15.5	16	5.5	Bal	2.5
Elgiloy				
Cr	Mo	Fe	Ni	Co
20	7	16	15	Bal
Inconel				
Cr	Mo	Fe	Ni	Nb
22	9	5	64.7 (Bal)	3.6
CB20-3				
Cr	Mo	Fe	Ni	Cu
20	2.5	Bal	33	3.2

In their most preferred forms, the devices of the invention are electrochemical cells such as the aforementioned types or are hermetic, corrosion resistant feedthrough assemblies for use for example in the manufacture of such cells.

Claims

1. An electrical device having a metal surface disposed about a feedthrough aperture, said aperture being sealed by a glass body contacting said surface, characterized in that said glass (12) is of a low-silica composition and in that said metal (14, 15) is a molybdenum containing alloy.
2. A device as claimed in claim 1 wherein said alloy (14, 15) contains at least 1% by weight of molybdenum.
3. A device as claimed in claim 1 wherein said alloy (14, 15) contains from 2 to 20% by weight of molybdenum.
4. A device as claimed in claim 1 wherein said alloy (14, 15) contains from 2 to 10% by weight of molybdenum.
5. A device as claimed in any one of the preceding claims wherein said alloy (14, 15) contains at least on

metal selected from Cr, Fe, Ni, Co, Nb and Cu.

6. A device as claimed in claim 5 wherein said alloy (14, 15) is selected from MP35N, 316SS, Hastelloy C-276, Elgiloy, Inconel and CB20-3.

7. A device as claimed in any one of the preceding claims wherein said low-silica glass (12) has the composition;

SiO_2 44.95 ± 4.0 weight percent,
Al_2O_3 20.0 ± 2.0 weight percent,
B_2O_3 8.0 ± 1.0 weight percent,
La_2O_3 2.0 ± 0.5 weight percent,
CaO 12.0 ± 1.0 weight percent,
MgO 7.0 ± 1.0 weight percent;
SrO 6.0 ± 1.0 weight percent, and
CoO up to 0.07 weight percent.

8. A device as claimed in any one of the preceding claims wherein said low-silica glass (12) is penetrated by an electrical lead (10).

9. A device as claimed in claim 8 wherein said lead (10) is of molybdenum, niobium, tantalum or an alloy thereof.

10. A device as claimed in either of claims 8 and 9 being an electrical feedthrough assembly comprising a sleeve or header member (15) of a molybdenum containing alloy disposed about a feedthrough aperture penetrated by a said lead (10) and having a hermetic compression-type seal provided by said low-silica glass (10).

11. A device as claimed in either one of claims 8 and 9 wherein said feedthrough aperture is in the wall of a container.

12. A device as claimed in claim 11 being an electrochemical cell having a corrosive material disposed in said container.

13. A device as claimed in claim 12 wherein said cell is based on lithium chemistry.

Fig. 1

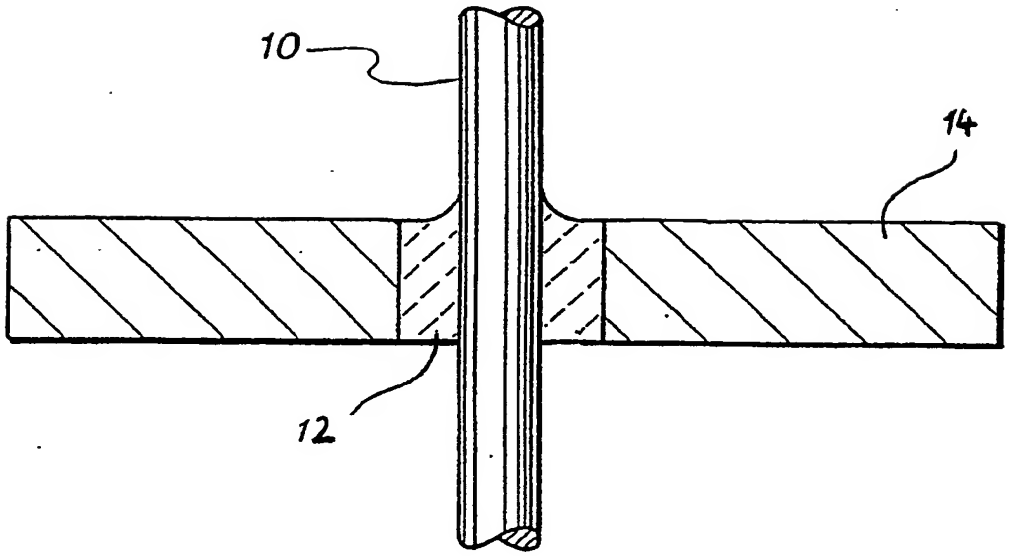
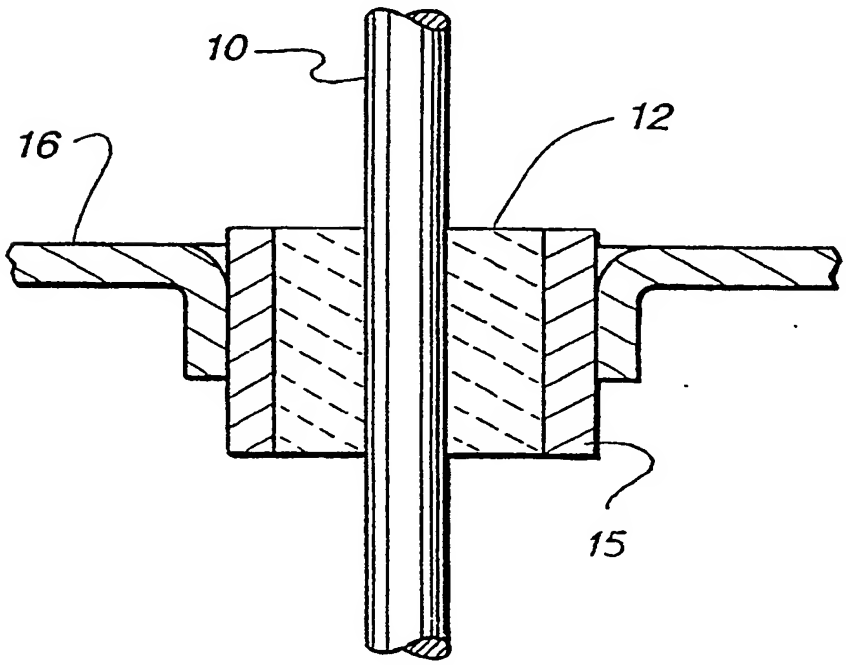


Fig. 2



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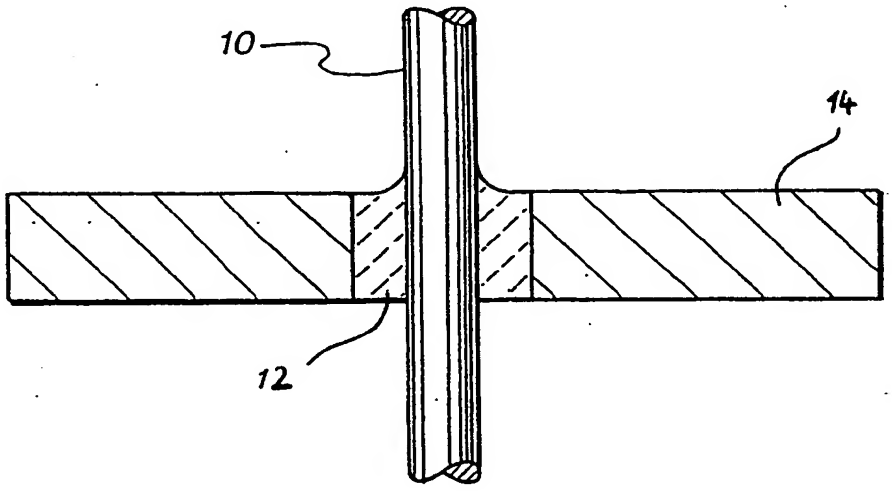

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EUROPEAN SEARCH REPORT

Application Number

EP 90 30 7569

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EXTENDED ABSTRACTS. vol. 84, no. 2, October 1984, PRINCETON, NEW JERSEY US page 828; S. C. LEVY AND ALL: 'Long-Life LI/SO2 Cells with Increased Reliability - Abstract no 567' * page 828, left column, paragraph 3 * *	1,7,9,12, 13	H 01 M 2/06 H 01 M 2/08 H 01 B 17/30 C 03 C 29/00 C 03 C 8/24
X	SANDIA REPORT - SAND83-2301/2 vol. 2, June 1984, pages 1 - 66; S. C DOUGLAS AND ALL: 'Ampule Tests to Simulate Glass Corrosion in Ambient Temperature Lithium Batteries' * page 36; table IA * *	1,7,9,12, 13	
X	US-A-4 792 503 (W. J EPPLEY) * column 3, line 17 - line 21; claims 1-3 * *	1-6,8, 11-13	
X	GB-A-2 056 753 (DURACELL INTERNATIONAL INC) * page 2, line 19 - line 28; claims 1,2; examples 1,2 * *	1,9-13	
X	CHEMICAL ABSTRACTS, vol. 109, no. 14, October 1988, Columbus, Ohio, US; abstract no. 113389W, BOVARD F. S. AND ALL: 'Corrosion susceptibility study of candidate pin materials for ALTC batteries' page 179 ;column 1 ; * abstract * *	1-6,10-13	
E	EP-A-0 404 435 (MEDTRONIC INC) * page 3, line 32 - line 36; table 1 * *	1,2,7-13	
A	EP-A-0 262 073 (EMERSON ELECTRIC CO.) * column 4, line 27 - line 56; claim 7 * *	1-5,8, 10-13	
A	GB-A-1 518 483 (P. R .MALLORY) * page 2, line 81 - line 86 * *	1	

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TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 M
H 01 B
C 03 C

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	29 November 91	D'HONDT J.W.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	FR-A-2 531 064 (SCHOTT GLASWERKE)		
A	WORLD PATENTS INDEX LATEST Section Ch, Week 8327, 23 August 1982 Derwent Publications Ltd., London, GB; Class L, AN 83-703912 & SU-A-952 786 (LENINGRAD LENSOVET TECH) * abstract * *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

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The Hague	29 November 91	D'HONDT J.W.

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O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

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